

Comparison of Laparoscopic Pyeloplasty With and Without Robotic Assistance

Jonathan E. Bernie, MD, Ramakrishna Venkatesh, MD, James Brown, MD,
Thomas A. Gardner, MD, Chandru P. Sundaram, MD

ABSTRACT

Objectives: The benefits of laparoscopic surgery with robotic assistance (da Vinci Robotic Surgical System, Intuitive Surgical, Sunnyvale, CA) includes elimination of tremor, motion scaling, 3D laparoscopic vision, and instruments with 7 degrees of freedom. The benefit of robotic assistance could be most pronounced with reconstructive procedures, such as pyeloplasty. We aimed to compare laparoscopic pyeloplasty, with and without robotic assistance, during a surgeon's initial experience to determine whether robotic assistance has distinct advantages over the pure laparoscopic technique.

Methods: We retrospectively compared the first 7 laparoscopic pyeloplasties with the first 7 robotic pyeloplasties performed by a single surgeon. All patients were preoperatively evaluated with computed tomographic angiography with 3D reconstruction to image crossing vessels at the ureteropelvic junction. All patients were followed up by lasix renograms and routine clinic visits.

Results: Patients were similar with respect to mean age (34 in laparoscopic pyeloplasty group vs 32 in the robotic pyeloplasty group), operative time (5.2 hours vs 5.4 hours), estimated blood loss (40 mL vs 60 mL), and hospital stay (3 days vs 2.5 days). Two patients in the laparoscopic pyeloplasty group had small anastomotic leaks managed conservatively, and one patient in the robotic pyeloplasty group had a febrile urinary tract infection necessitating treatment with intravenous antibiotics. Another patient in the robotic pyeloplasty group was readmitted with hematuria that was treated conservatively without transfusion. No recurrences were detected in either group.

Conclusions: Operating times and outcomes during the learning curve for laparoscopic pyeloplasty were similar to those for robotic pyeloplasty. Long-term data with greater experience is needed to make definitive conclusions about the superiority of either technique and to justify the expense of robotic pyeloplasty.

Key Words: Laparoscopy, Robotics, Ureteral obstruction, Ureteropelvic junction obstruction.

INTRODUCTION

Ureteropelvic junction (UPJ) obstruction is a condition where urine flow and transport from the kidney to the upper ureter is impaired, due to a variety of causes (intrinsic obstruction—aperistaltic segment, kinks, and strictures; extrinsic compression—crossing vessels). Several management options are available for this problem, including open surgery (OP), antegrade and retrograde endourologic techniques, and laparoscopic repair (LP).¹⁻⁵

To our knowledge, no study has evaluated and compared an individual surgeon's initial experience with laparoscopic pyeloplasty, with and without robotic assistance. Recently, Ahlering et al⁶ reported their initial experience with robot-assisted laparoscopic radical prostatectomy and concluded that robotic skills are quickly acquired, even by a laparoscopically inexperienced surgeon. We aimed to compare laparoscopic pyeloplasty, with and without robotic assistance, during the initial experience of a laparoscopically experienced surgeon, to determine whether robotic assistance has distinct advantages over the pure laparoscopic technique.

METHODS

Between 1999 and 2003, patients diagnosed with UPJ obstruction and subsequently treated with LP or RP by a single surgeon (CPS) were identified, retrospectively reviewed, and compared. Computed tomographic (CT) angiograms were obtained in all patients preoperatively. Patients with UPJ obstruction were given the options of endopyelotomy or laparoscopic pyeloplasty. The expected results following endopyelotomy and laparoscopic

Department of Urology, Indiana University School of Medicine, Indianapolis, Indiana, USA (Drs Bernie, Brown, Gardner, Sundaram).

Division of Urologic Surgery, Washington University School of Medicine, St. Louis, Missouri, USA (Dr Venkatesh).

Address reprint requests to: Chandru P. Sundaram, MD, Department of Urology, Indiana University School of Medicine, 535 N Barnhill Dr, Ste 420, Indianapolis, IN 46202, USA. Telephone: 317 278 3098, Fax: 317 274 0174, E-mail: sundaram@iupui.edu

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pyeloplasty given the preoperative characteristics of the individual patient were discussed with each patient before selecting the treatment modality. The LPs were performed in 1999 through 2002 by using interrupted sutures for the anastomosis. An effort was made to achieve a watertight closure. The RPs were performed from October 2002 to September 2003. Objective data collected from the chart review included demographics and preoperative data (age, sex, weight, height, body mass index), intraoperative data (total operative time and estimated blood loss) and postoperative data (length of hospitalization, analgesic requirements, complications, follow-up radiographic images, and clinical subjective improvement). A definition of favorable outcomes included a patent ureteropelvic junction confirmed by a radionuclide diuretic renogram as well as subjective clinical response, which was ascertained from review of follow-up clinic appointments. Subjective results were determined from the improvement in the analog pain scores of the patient at the last follow-up.

Operative Technique with Robotic Assistance

Cystoscopy and ureteral stent (6 French) placement under fluoroscopic guidance is first achieved with the patient in the standard lithotomy position. Retrograde pyelography is performed to confirm the diagnosis of a ureteropelvic junction obstruction. The length of the UPJ obstruction, the size of the pelvis, and the presence of a crossing vessel helps determine the type of UPJ repair. The upper end of the ureteral stent is positioned in the upper calyx of the kidney to allow for movement of the stent during manipulation of the UPJ without dislodgment of the lower end of the stent into the distal ureter. The patient is repositioned and the laparoscopic technique is performed with the patient in the flank position and a mild degree of flexion of the operative table. Pneumoperitoneum is established in the ipsilateral midclavicular line at the level of the umbilicus, and an 8-mm da Vinci trocar is placed. A 12-mm trocar is placed at the umbilicus. The second 8-mm da Vinci trocar is placed 8 cm to 10 cm above the umbilicus in the midline. A 12-mm trocar is inserted 6 cm to 8 cm below the umbilicus in the midline. This port is used by the assistant for suction/irrigation and for insertion of the sutures and needle. On the right side, a 5-mm trocar is used in the subcostal region in the midline to help with anterior retraction of the liver, using a locking grasper at the lateral abdominal sidewall. The position of the trocar is selected depending on the location of the lower edge of the liver. The da Vinci Surgical System approaches the patient from a 30-degree cephalad direction. The colon is then dissected and retracted medially. Dissection is facil-

itated with a hook-cautery, graspers, and bipolar cautery. The ureter is identified, traced to the ureteropelvic junction. The stenotic segment is excised as necessary. The divided ureteral end is spatulated laterally for 1 cm. The upper end of the stent is removed from the renal pelvis and the pelvis spatulated. If an anterior crossing vessel is present, the renal pelvis is transposed anterior to the vessel and the posterior anastomosis performed with a running 4–0 polyglactin suture, 6 inches in length. The proximal coil of the stent is then replaced into the renal pelvis and the anterior anastomosis completed with a second running suture. A reduction pyeloplasty is done if a redundant pelvis is present. A nondismembered Fenger-plasty is performed if no crossing vessel is present and there is focal stenosis. Interrupted sutures are used for nondismembered repair. One patient with a 3-cm long UPJ stricture underwent a spiral-flap pyeloplasty. A 10 Fr or 15 Fr drain is inserted through an 8-mm lateral trocar site. Flexible cystoscopy or fluoroscopy confirms proper positioning of the distal coil of the stent, and a Foley urethral catheter is inserted. The urethral catheter and the drain are removed on the second postoperative day, before the patient is discharged home. The ureteral stent is removed in about 6 weeks. Follow-up appointments are scheduled at 8 weeks to 12 weeks after stent removal, at 6 months, and annually thereafter.

RESULTS

Patient perioperative data are demonstrated in **Table 1**. Fourteen patients underwent laparoscopic pyeloplasty during the study period, 7 with and 7 without robotic

Table 1. Perioperative Data for Laparoscopic Pyeloplasty With and Without Robotic Assistance		
	Laparoscopic Pyeloplasty n = 7 (Range)	Robotic Pyeloplasty n = 7 (Range)
Mean Age (years)	34 (18–55)	32 (25–49)
Mean BMI	24 (19–31)	26 (21–32)
Operative time (hours)	5.2 (4–6.5)	5.4 (4.2–7)
Crossing Vessels	6	4
Dismembered Repairs	6	4
Estimated blood loss (mL)	40 (5–200)	60 (50–100)
Length of hospitalization (days)	3 (2–4)	2.5 (2–6)
Complications	2	2

assistance. The two patients in the LP group had small anastomotic leaks (diagnosed by elevated drain fluid creatinine levels) that resolved with conservative treatment with a drain and a urethral catheter for a week. One patient in the RP group had a febrile postoperative urinary tract infection that required intravenous antibiotics. Another patient in the RP group was readmitted 2 days after discharge with hematuria due to minor bleeding from the anastomotic site. The patient was treated conservatively with analgesics and did not require blood transfusion. Follow-up was 10 months (range, 5 to 15) in the RP group and 24 months (range, 22 to 30) in the LP cohort. Pain analog scores were administered to patients in the RP group. The mean pain score improved from 8 preoperatively to 2 postoperatively. All 14 patients have done well with improvement in renal function (30% to 44%) and normalization of $t_{1/2}$ on lasix renography.

DISCUSSION

LP can be performed by either conventional laparoscopic techniques or using robotic assistance. The perceived advantages of RP are improved dexterity and precision with suturing, shorter learning curve for surgeons, improved visualization of the operative field, and shorter operative times, with equivalent outcomes as those for conventional laparoscopy.^{7–13} Nevertheless, disadvantages to robotic-assisted laparoscopic surgery are no tactile feedback, increased setup time, and cost. Gettman et al¹⁴ retrospectively compared their initial 6 patients after RP with 6 age-matched LP controls and concluded that operative times were improved with robotic assistance (140 min vs 235 min) as was suturing time (70 min vs 120 min). Hospital stay (4 days), estimated blood loss (<50 mL), and complications (none) were equivalent between the 2 groups. In another review¹⁵ with 9 patients, in which a 4-port RP technique was used, operative time was 139 minutes, suturing time was 62 minutes, hospitalization was 5 days, and blood loss was minimal. In our study, the operating times were longer. The times reported included the preoperative cystoscopy and stent placement as well as the time for setting up the robotic system. Furthermore, our overall experience with the robotic system had been minimal, before this series of patients. Because more surgeries, such as the laparoscopic radical prostatectomies, are performed with robotic assistance, the operating times will significantly decrease. We have noted a significant decrease in our robot setup time since this series of patients underwent surgery. The lack of tactile feedback with the robotic system during the early experience may adversely effect delicate dissection in the region of the

crossing vessels. During procedures in the first 2 of our patients in the robotic series, we used traditional laparoscopy for initial dissection of the ureter and the crossing vessel. However, with experience, the improved 3D visualization allowed the surgeon to perceive tissue consistency and the tension on the sutures during knot tying.

The anastomotic leaks that occurred with the LP patients could be related to the relative inexperience of the surgeon with the procedure. Furthermore, Fengerplasties are less likely to leak compared with the dismembered repairs. However, the impression is that the anastomosis is less challenging with robotic assistance and can be reliably performed with less experience.

This study has several limitations. First, the number of patients in the study was small. Also, this was a retrospective review with the entire LP cohort performed initially, and the RP performed after the surgeon had gained more experience with the procedure. Lastly, the types of repair and suturing techniques were not similar in the 2 groups. Nevertheless, it is our impression that outcomes in the RP are equivalent to those in the LP group. Longer follow-up and a larger patient cohort would certainly solidify our conclusions and determine other differences not elucidated in this small series.

CONCLUSION

Because robotic-assisted pyeloplasty is a new technique, evidenced by fewer than 10 patients in most series, more experience is needed to better determine the relative advantages of the RP procedure. From this review, in the surgeon's initial learning curve, a significant difference in perioperative variables or outcome does not appear to exist.

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